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Thematic Color Design for Children's Hospitals

¹Rawa Ali AbuLawi,

An-Najah National University, Nablus, Palestine.

Abstract.

This research has explored the thematic color preferences and the psychological effect of color within the interior design of healthcare interior spaces, particularly children's hospitals public spaces, in the context of Palestine. The literature indicates that research is needed to identify the colors that provide healing environments for all age ranges of children. The data collection was classified into prime sources and secondary sources. Primary research was carried out in Palestine to enable the collection of data that fits the exact purpose of this research and to increase the reliability of the information. In Palestine, qualitative data were collected during nine co-design and co-creation workshops, including art-based activities and semi-structured interviews. The secondary sources are related to the broad literature review focusing on empirical studies pertaining to design children's hospitals. The study uses a thematic analysis approach for analyzing the qualitative data. This research's key findings identify thematic colors that are appropriate for all age ranges of children (i.e., green, blue, yellow, brown/wood, and purple colors). In addition, the findings revealed a strong preference by all stakeholders to include colors connected to nature for the design of children's hospitals in the context of Palestine

Keywords: public spaces, children's hospitals, participatory research, interior design, colors to healing.

1. Introduction

This paper aims to identify the thematic design of colors for children's hospitals' interior design. The selection of color for the interior design spaces dramatically impacts the well-being of sick people and the medical staff, particularly children. Therefore, the choice should be based on specific criteria, specifications, and strong scientific causes that consider the psychological and physiological impacts and the aesthetic effects on the concerned people (Elqahtani and Elgizaw, 2015). Color can affect buildings, shapes, and forms by helping to distinguish between different elements (Zetterquist, 2009). According to NHS Estates (2004), Colors can change the image of architecture, present it as a piece of art full of colors, or show it like abstract art. Using color is considered "*a powerful tool and should be carefully specified for each child*" (p.18). In addition, color is regarded as an inseparable part of our lives. Although we still find several new hospitals built in the last years have been lacking in Color (Bosch et al., 2012). Hospitals have a wide range of users with different requirements,

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from the elderly to the very young (Zraati, 2013). Hence, it is essential to create appropriate interior design spaces that are comfortable for all users. Including proper colors is one of the crucial elements that affect people's psychological and physiological issues. Designers should consider that adult people experience colors differently from children (Elqahtani & Elgizawi, 2015). Thus, it is essential to identify the appropriate types of color and to understand how to apply colors in healthcare environments from the users' perspectives, particularly children (Bosch et al., 2012).

1.1 Psychological and Physical impacts of Colors

Color is a fundamental factor in environmental design. It strongly influences aesthetic and technical aspects of healthcare environments, affecting human psychology and physiology (Ghamari & Amor, 2016). According to Engelbrecht (2003), color can be transmitted through the human eye, and then the brain releases the hypothalamus hormone, which affects our moods, emotion, mental clarity, and every level.

Based on the literature review, bright colors were associated with mainly positive emotions, and dark colors were associated with negative emotions (Ghamari & Amor., 2016)). Bosch et al. (2012) demonstrated that painting white walls provides people with clarity and signifies cleanliness. However, walls with white colors could provoke a sense of clinical and eerie. Using soft colors for walls, like yellows, greens, or blue, might promote a calming effect, but much white color can give feelings of separation and be cold and isolated (Powers, 2009). However, warm colors can be used to reduce the scale of the area, and cold colors visually enlarge a space, making it less confining, and it can make the appearance of the room dull or pleasant.

Furthermore, warm colors can arouse feelings, but cool colors can calm emotions (Dijkstra et al., 2008). For instance, using red and yellow to paint the interior walls of two rooms showed a significantly higher anxiety score than those in blue and green rooms (Jacob & Suess, 1975). Zaraati (2013), in his evaluation research about the appropriate colors used in waiting areas in two hospitals in Malaysia, found that users prefer warmer colors such as yellow-brown because they make the room feel more sociable. However, they do not prefer strong colors like red-orange to decorate the waiting room because they increase the patient's patience level, leading them to be restless while they wait in the room. In addition, the stakeholders' preferred a lighter color (such as white, cream, and light gray tone) for the floor, ceiling, wall, and furniture. Although warm and cool colors have opposite effects on human minds, combining them can create comfortable atmospheres and settings (Rahmatabadi et al., 2011). The color and emotion relationship is closely tied to color preference which this research will cover.

1.2 The importance of color in the healthcare environment

The literature review identified the potential influence of colors in providing interior healing spaces (Tonkin, 2015). Color, considered one of the most important components of

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the physical environment in healthcare settings, may improve patient and staff satisfaction (Zraati, 2013). For instance, color can affect patient recovery rates, promoting a sense of well-being, improving the quality and overall experience of patients, staff, and visitors (As Cited in Ghamari & Amor., 2016). Appropriate implementation color design can give people a feeling of calmness, provide identity to the architectural environment, reduce stress, provide a powerful tool for coding, navigation, and wayfinding (ibid). For instance, choosing the appropriate color for textures and materials can provide visual and tactile cues to effectively use a healthcare building to help people with poor vision (Dalke et al., 2004). Edelstein (2008) demonstrated that the color spectrum of light directly influences human biological systems and health outcomes. For the above reasons, much attention should consider when thoughtfully designing and shaping the interior design of the healthcare environment (Bosch et al., 2012).

Using color in healthcare interior spaces can provide various feelings and affect human beings' psychology and physiology (Ghamari & Amor., 2016). In the interior design of children's hospitals, color is used to provide a child-friendly environment. For example, in Birmingham Children's Hospital, Color is associated with child-friendly atmospheres and was extensively used in children's hospitals to create colorful environments (Ulrich et al., 2008). In a study by Zarrati (2012), the interior design related to the Subang hospital in Malaysia is more welcoming for visitors and patients than Sunway hospital. In Subang hospital, the light color is most used, especially pink and blue for the sofa, floor, wall, ceiling, and lighting for the waiting area, thus providing a relaxed and calm feeling.

On the other hand, light blue used for floors makes patients and staff feel quiet and away from the rush of the day. However, the warmest color has been used for the sofa, floor, wall, and ceiling lighting in Sunway hospital. The yellow color was applied for walls to make self-confidence, encourage optimism to the area, and bring on feelings of fear. Brown Color that used for furniture and carpet to bring feelings of stability and security (Ulrich et al., 2008).

The literature review identified the potential influence of colors in providing appropriate and comfortable interior spaces. However, we still find a few studies argue that there are no specific colors that should be applied in the healthcare interior spaces, particularly public spaces of children's hospitals, due to psychological or cultural reasons. Tonkin (2015, p.82) said no more extended use of primary colors in hospitals because scholars have judged them inappropriate and can cause a sense of disturbance. In the interior design environment, designers should avoid using plain red, yellow and blue for furnishing and décor because they can cause aggressive behavior (Ceppi & Zini cited in Del Nord, 2006). A few studies (e.g., Tivorsak et al., 2004) suggested using neutral colors for secondary waiting areas to provide comfort. Other studies prefer to avoid using bright colors because they create a busy and chaotic environment in the atrium (Koller & McLaren, 2012; Coad and Coad, 2008). However, using bright colors in waiting areas can affect user motivation and stress levels (Zraati, 2013). At Pittsburgh children's hospital, the designer used bright colors for the waiting rooms, atrium, and reception area to distract the children's attention from their clinical surroundings (Powers, 2009; Miller, no date). Due to these contradictions in color preferences, these

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findings need more investigation to be generalized. Thus, this research will cover these gaps.

1.3 Color Preferences according to age, gender, and culture

The selection of color has a significant impact on the well-being of sick people and the medical staff. Therefore, the selection should be based on certain criteria, specifications, and solid scientific causes that consider the psychological and physiological impacts and aesthetic effects on the stakeholders, age, gender, and culture (Elqahtani & Elgizawi 2015).

A study used 842 subjects to investigate the effect of aging on color preferences and found that blue was the most preferred color and yellow was the least preferred for younger and older adults (Dittmar, 2011). The adult preference for blue decreased gradually as age increased, whereas the appreciation for green and red increased. Such findings lead to conclude adult color preferences change throughout the adult life span (ibid).

Color is still essential to children's hospitals (Schneider, 2010). It's essential to appeal to all ages through the use of softer colors and a natural palette. Designers should consider using a variety of colors, however, because single-color schemes get tiresome. However, the color palette for children's cancer facilities should not include red because it reminds children of their chemo drugs (ibid). According to Coad and Coad (2008), the thematic interior design for some children's hospitals is unsuitable for all ages. For example, in Bristol Children's Hospital, children reported that thematic design features (i.e., art, images, design, and colors) are "too young." In another study, children preferred nature scenes dominated by greens and blues, and very few preferred the inclusion of turquoise, black, and orange (Lankston et al., 2010). Park (2009) examined color preferences among pediatric outpatients, inpatients, and healthy children and found no statistically significant difference in color preference among the three groups of children. Therefore, it did not support the hypothesis that pediatric patients would have different color preferences than healthy children. However, all preference comparisons revealed that white was the least preferred Color (Bosch et al., 2012). Blumberg and Devlin (2006) used a demographic questionnaire, a photographic comparison test, and a design questionnaire with 100 junior high school students. The results indicated that that adolescent prefers the bright colors in the hallway. Lambert et al. (2014) conducted a participatory art-based approach. The data were collected from 55 children (aged five-eight years) across three children's hospitals in Ireland. Findings revealed that young children want a hospital environment that is bright, cheerful, warm, colorful, and comfortable. Children wanted color everywhere and suggested using neutral colors (e.g., green, yellow) to accommodate unisex tastes.

Based on the literature review (Ellis & Ficek, 2001), the responses to color preferences may vary according to gender. For example, blue was preferred more by adult males than by adult females as the most preferred color; yet blue was still the most preferred color (followed by red) for both genders.

Culture seems to influence color preferences. Coad and Coad (2008) state that there are *"no absolutes in color and design preferences due to the many psychological or cultural*

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reasons" (p.44). According to Ghamari and Amor (2016), blue was most preferred by Caucasian children in grades 1 through 10, red was selected most often as a favorite color by Mexican children in grades 1 through 7, 11 to 21- year-old full-blood Native Americans, as well as 6 to 17-year-old Filipino children. Park & Park (2013) used physical model simulation to: (1) investigate environmental color preferences in American and Korean pediatric patients'; and (2) to examine gender differences in color perception. The research included 21 boys and 21 girls in forty-two American pediatric patients, and fifty Korean pediatric patients had 30 boys and 20 girls. The age range of children was between 11-17 years. The results of the study showed that:

- The cultural difference was found in choosing the white color where Korean participants showed significantly higher preference scores for white Color than Americans.
- Both groups reported blue and green as their most preferred color, but white was the least preferred.
- Similar gender differences were found across both of the groups. Overall, male patients reported significantly lower preference scores for red and purple than females participants did.

Based on the above discussion, choosing the appropriate color for interior healthcare environments should consider age, gender, and culture. Despite this, further exploration and evaluation are needed in larger studies that consider these variables, and this research will cover that.

1.4 Design with and for children

According to literature (e.g., Read and Upington, 2009), there is a shortage of studies consider children's color preferences. It appears to be adults who always choose the colors and materials for children in a hospital environment. Coad and Coad (2008) and others pointed to the importance of themes in hospital environments. In their research, there is limited evidence that children participate in deciding to plan their preferred décor in terms of thematic design and color in healthcare environments (ibid). For the above reasons, this area requires further investigation, and my research will cover this gap.

Design for children should be distinct from design for adults because of children's cognitive development (James et al., 1998). Piaget explains that children are not less intelligent than adults; they think differently (Lueder & Rice, 2007). They can learn by doing and perceiving the world only as they have experienced it (Singer & Revenson, 1997). In Piaget's theory, "*all children must be able to understand the world in concrete terms before they can begin to think in the abstract*" (ibid, p.19). According to Piaget's theory, children can be divided into four age groups (i.e., sensorimotor—0-2 years, pre-operational— 3-7 years, concrete operational— 7-11 years, formal operational—11-18 years). At each age, children should choose different types of colors. No age group can choose or prefer the same kinds of color as the other age groups (Piaget, 2003; Eisen, 2007). That leads to hypothesize that every age range of children will choose different types of colors. For the above reasons, this

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research will examine four stages of children's cognitive development and their effect on identifying age-appropriate thematic colors for children.

1.4 Hospitals in Palestine

In Palestine, a lack of research was conducted about the appropriate types of interior design elements (i.e., color) that can be included in the interior spaces of hospitals that hospitalized children (AbuLawi, 2017). Although Palestine has eighty-three hospitals, no dedicated children's hospitals can hospitalize children from 0-18 years old (Stilwell et al., 2014). There are seven hospitals in Nablus city (the focus of this research) (Al Sharif, 2008). Two of them have wards that can treat children. One of them is at Rafidia Surgery Hospital. It is considered one of the largest hospitals in Palestine and the only public sector hospital in Nablus that can accommodate children (Abulawi, 2017). It is a public sector district hospital with a well-established pediatric capability, serving about 300,000 people, and providing numerous specialties (for all services and departments, see Al Sharif, 2008). According to an evaluation by Arscott-Mills in 2008, the interior design of the main entrance, atrium, and corridors faced a lack of quality in terms of thematic design color that is appropriate and conducive to healing for children. At Rafidia Surgery Hospital, The corridors are painted white and dark brown and tiled with yellow marble for hygiene and infection issues (see Figures 1-3). Some of the thoroughfares are covered with wallpapers with classic decorative themes that children might not prefer. Thus, this research will be conducted in Palestine to provide deeper insights into these areas.

Based on the conducted literature review, six issues are highlighted and shapes the objectives of data collection:

- The research literature of studies that contribute to the color used in the healthcare environment is fragmented and questionable.
- Designers should consider all users (i.e., patients, caregivers, visitors, and the community).
- There are considerable contradictions related to the application of color design strategies guidelines.
- There was insufficient evidence to link specific colors with specific behavioral or health outcomes directly.
- It is essential to consider color preferences across age and cognitive development, gender, and culture.
- There is a shortage of studies that consider children's color preferences related to healthcare interior spaces, particularly public spaces.
- In Palestine, there is a lack of research about the appropriate interior design elements (i.e., color) used in hospitals hospitalized children.
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Figure 1: Main entrance-Rafidia Surgery hospital.

Figure 2: Atrium -Rafidia Surgery hospital.

Figure 3: The interior corridor of the Pediatric Department at Rafidia Surgery Hospital.

Based on the above discussions and reasons, *what is the appropriate thematic design concept related to color for all age ranges of children and other users for children's hospitals, particularly public spaces in Palestine?*

2. Methodology Methods

This research employs two main methods to collect the secondary and the primary data:

Method 1: Conducting a broad Literature review related to journal articles, books, and reports of previous empirical studies in multiple disciplines to identify theories, which could have design implications for color in healthcare design, particularly for children's hospitals. The reviewed literature's main disciplines are healthcare, medicine, psychology, environmental and interior design, and environmental psychology. The reviewed literature helped in the data collection of primary research.

Method 2: This method employs a participatory qualitative study that uses nine co-design and co-creation workshops format. The number of participants is 52 (see Table 1). Such a method was carried out to collect the primary data to achieve the purpose of this research and increase the information's reliability. Data collection took around two months. Before starting the data collection, the researcher acquired all necessary ethics approvals from the An-Najah National University, Ministry of Health, and Education in Palestine. The data collection process for the preliminary data was divided into four steps:

Step 1

Workshops with school children aged 6-18 years to create drawings and 3D models. The eighteen participating school children were divided into six groups. In these workshops, the children were asked to create freestyle drawings with the following activity titles: (1) My favorite places that make me feel safe, happy, and playful; (2) A place where I would like to be while I am waiting my turn (Johnson et al., 2012). This method prevented bias of the responses because the term 'hospital' was not mentioned in children's workshops. Drawings can be used as an evaluation tool to reveal a child's feelings, thoughts, and emotional problems (SilavUtkan, 2012). This method can be more efficient than verbal expression because children can express their inner desires through the pictures they draw (ibid). The children used A3 sheets of paper, pencils, sticky notes, scissors, crayons, stickers, and collage

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materials. Children also created models that helped draw out their ideas, perceptions, and insights. These methods help create inclusive insights into children's social world, which cannot be achieved through traditional anthropological data collection methods (Johnson et al., 2012). These methods and tools are considered relevant, suitable, and enjoyable to children (ibid). Then the children were asked to explain their drawings and to write down their explanations. Each child had a chance to describe their drawings verbally. Their interpretations of their drawings were recorded for analysis. The inclusion of the children's interpretations of their drawings in conjunction with the three-dimensional model's method (Guillemin, 2004) helped identify new themes related to children's interior design spaces, particularly their preferences of colors.

Table 1: Number of Samples and Data collection process

Samples and Data Collection Process		
Steps of Data Collection	Workshops	Samples Size
Step 1	Workshops with children	18 school children: (9 male (m) and 9 female (f)), 5 children under six years: (1m & 4f). They were divided into six groups: <ul style="list-style-type: none"> • Children from governmental schools aged 6-7 years (Location: Bait Wazan elementary school). • Children from private schools aged between 1-8 years (Location: Pioneers Schools). • Children from private schools aged between 1-10 years (Location: Pioneers Schools). • Children from private school Aged between 12-14 years (Location: Pioneers Schools). • Children from government schools aged between 15-18 years (Location: Al-Malik Talal Schools). • Children from private schools aged between 15-18. (Location: Tala'a Al-Amal Schools).
Step 2	Workshops with parents	8 parents: (4m & 4f)
Step 3	Workshops with medical staff	9 medical staff: 3 doctors (1f & 2m), 4 nurses (2f & 2m), 2 staff members (f) working in admissions and reception
Step 4	Workshops with four groups of designers	12 designers (7m & 5f)

Step 2

Parent Workshops and Focus Groups. These workshops were conducted to identify the needs of parents and their young children aged between 0-3 years. In these workshops, the

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thirteen participants were divided into three groups: one for fathers, a second for mothers, and a third for children aged 3-5. An equal number of men and women were chosen. Gender was an essential contextual variable in this research, so a purposive sampling was used to obtain similar numbers of mothers and fathers (Gray, 2014). The parents participated in two activities:

- **Flow Chart.** Parents were asked to draw a flow chart that outlined their preferences when entering hospitals with their young children (0-3 years) pertaining to aesthetics (i.e., Colors) that provide them with comfortable environments.
- **Three-Dimensional Models.** Like their children, the parents were provided with the same materials to create 3D models. They were asked to develop a model to express their preferences and their young children's needs to feel happy and comfortable if they entered a hospital. Through that, they identified their color preferences.

Step 3

Medical Staff Workshops and Focus Groups. There were eight participants in the activities. Eight healthcare professionals, divided into four groups, participated in three activities:

- **Tables.** Three tables were classified. These tables included lists of parents' and children's preferences regarding interior design for children's hospitals' public spaces. The groups had a chance to arrange and classify the initial choices regarding interior design elements, including types of color.
- **Flow Charts.** The four groups were then asked to list their preferences and need to make them feel happy and comfortable, in terms of aesthetic issues, during their work, and particularly in the pediatric hospitals' public spaces. The four groups created four flow charts.
- **Discussion of a Model that Included Preferences of Workshops for Children and Parents.** The researcher explained the children's and parent's needs that emerged from their respective workshops. This activity aimed at addressing and identifying any contradictions and inconsistencies between health professionals' public space requirements regarding types of colors and children's and parents' preferences.

Step 4

Workshops with designers. These workshops were conducted to design themes for colors related to a pediatric hospital's public spaces. This phase involved workshops for four groups of designers in Palestine. This method can strengthen the collection of rich perspectives from the participants and support the stakeholders' input through activity-based research (Hanington & Martin, 2012). The workshops involved a sample of 12 participants, based on the available time and resources (SilavUtkan, 2012). Before conducting this workshop, some initial analysis was made of the children, parents, and medical staff workshops, using tables, reports, and memos. The initial data were sorted according to the four groups of designers and questions identified for each group. The findings and workshop agenda were presented, and questions were taken before and during the group work.

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- **Interior Architecture:** This group of designers discussed the initial results of the data that emerged from Phase 2 workshops. They were asked to draw sketches and diagrams on A3 and A4 sheets. They used hexagon cards to present their ideas on interior architectural elements highlighted by parents, healthcare professionals, and children, particularly schematic colors preferred by participants.
- **Interior Designers:** Like the interior architecture group, the interior designers followed the same steps with their ideas concentrating on interior design elements in the artwork's particular colors.
- **Graphic Designers:** These designers suggested some ideas focusing on thematic design colors related to wayfinding signs.
- **Plastic and Ceramics Artists.** These artists jotted down their suggestions and ideas about the concept thematic design of colors using the hexagon cards. This group highlighted the importance of using children's drawings and models to include colors in creating art. For the participants' drawings and models, see figure 4.

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Figure 4: Samples of participants' artwork.

3. Data analysis and Findings

A thematic analysis approach was used to analyze the primary data (Braun & Clarke, 2006). It is a valuable method that uses a participatory research paradigm that includes participants. It is collaborative, can help create an initial analysis that can shape further data collection, highlight similarities and differences, and allow for social and psychological interpretations of the data (ibid). The data analysis presented that parents, children, and medical staff expressed their preferences for including different colors to provide comfortable environments.

According to children, they have similarities and differences in terms of including colors. The analysis of their art-based activities and semi-structured recorded interviews identified eleven colors. The great majority prefer green and blue (17/23); most of them (13/23) prefer yellow; also few of them (11/23) prefer wood and purple, and a few (10/23) prefer pink. More preferences are presented in Table 2. The excerpts below also provide examples of children's preferences in terms of colors.

I like the light colors such as yellow, green and light pink. I like them because they make me feel comfortable. I like blue, green and purple—also, Turquoise (a mixed with green-blue), sky blue, and light green. I prefer light blue, green, light yellow, which is look like sand. However, there are colors; the one when you look at him feels uncomfortable. For example, the red color when one is studying he cannot learn, he becomes angry. I'm not too fond of the red color because they stimulate angrily (Three children\boys, 15-18 model activity).

I like wood colors, green, and the color of water because it gives you a feeling of splendor and can express nature's colors. I want to merge the old colors with modern ones (aged 15-16 years).

We all like the light colors that provide us with excitement and can remember us with summer colors. In winter, many people can feel depressed with dark colors. However, light colors make them feel with activity and vitality and like this. The color of the pool is dark blue, the color of the flower which is here the fuchsia color, green and yellow (Girl, 16-17 years).

The participants of adults demonstrated their preferences in including colors in their artwork because they provide comfort. They suggested several types of colors in different spaces. For instance, most of them prefer including green colors in the main entrance to distract and

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attract children; however, few (2/18) prefer including light colors in the reception areas. More preferences are presented in Figure 5 and Table 2.

The excerpts below presented some of the preferences of parents and medical staff.

The first thing is to have the main entrance and a garden. The most important thing is to have a garden with green things and green colors [...] because the child is attracted to nature (Mother, chart activity).

The area of games should have bright and light colors so the child can enter it at any time. We prefer this area (main entrance) to be provided with soft colors and found in the main entrance to attract the child's attention and distract him. However, the x-ray has no problem with its location beside children's spaces, but it should have lights and colors that can attract the child and reveal his fears (Medical staff, chart activity).

I prefer the main entrance to be provided with light colors. I like to see it in the main entrance to attract the child's attention and distract him (Medical staff, Model activity).

Table 2: Parents (P) and medical staff (MS) preferences regarding including colors in children's hospitals' main entrance and atrium.

Preferences of parents and medical staff regarding types of colors	Participants	Total number
Colors for the floor tiles of the atrium that enable easy wayfinding	8 (P), 9 (MS)	17/17
Colors for the main entrance that are attractive to children	4 (P), 10 (MS)	14/18
Natural green colors for the main entrance distract and attract children	4 (p), 8 (MS)	12/18
Colors for the triage room to provide a positive distraction	9 (MS)	9/9
Bright colors for the reception area	2 (P), 3 (MS)	5/18
Bright colors for play areas		
Light colours for reception areas	1 (p), 2 (MS)	3/18
Colors for x-ray room that help decrease fears of children	2 (MS)	2/8

The participants of designer also acknowledged the importance of including colors in the public spaces of children's hospitals (see Table 3).

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Table 3: Designers' suggestions regarding appropriate colors for the public spaces of children's hospitals

Designers Suggestions Regarding Using Colors	
Designers groups	Examples
Interior architecture	<ul style="list-style-type: none"> All the interior architecture designers appreciated using colors as a means of surprise for children to move their perceptual. That might be achieved by providing every space with a specific color. All the interior architectural designers appreciated using colors to code the interior architectural spaces that might help provide identity to the areas that assist in providing secure wayfinding. To them, that can be achieved by applying colors through materials and textures.
Interior Designers	<ul style="list-style-type: none"> All interior designers group appreciated using light colors, green, blue, and nature colors in the reception, waiting, and main entrance to lighten up children's eyes and decrease their fears.
Artist and ceramic	<ul style="list-style-type: none"> All artists and ceramic groups appreciated using colors to create appropriate types of art that fit children.
Graphic designers	<ul style="list-style-type: none"> All graphic designers acknowledged using colors for the wayfinding signs, but the colors should be integrated with interior design and interior architecture concepts and elements. For instance, using green colors for the emergency, blue colors for waiting areas, etc.

Examining the preferences of colors between boys and girls, I noticed no significant differences between boys and girls within the same age range. Unless in the age range between 15-18 years. It has been noticed that two girls prefer brown\wood colors, but no one of the boys prefers that, and two boys prefer yellow colors, but no one of the girls prefers it. Moreover, there is a difference between boys and girls among the whole age ranges of groups presented that: five girls prefer white color versus no boys, eight girls versus three boys prefer purple colors, seven girls versus four boys prefer wood colors, and eight girls versus two boys prefer pink colors. In comparison, girls' most appreciated colors are green, blue, purple, pink, wood, and yellow. Whereas *green, blue, yellow, and wood* are the most appreciated by boys. Thus, *green, blue, wood and yellow* are the colors that both/boys and girls appreciate. Moreover, comparing the preferences between parents and children, green colors were preferred by most of them (21/40); and bright and light colors were preferred by a few (11/40) of parents, medical staff, and children.

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Children's preferences in terms of colors		
Types of color	Participants of children	Total number
Green	2F, 1M (CH) 3-6 years 1F, 2M (CH) 6-8 years 2F, 2M (CH) 8-11 years 2F (CH) 12-14 years 2F, 3M (CH) 15-18 years	17/23
Blue	2F, 1M (CH) 3-6 years 2F, 2M (CH) 6-8 years 2F, 2M (CH) 8-11 years 1F (CH) 12-14 years 3F, 2M (CH) 15-18 years	17/23
Yellow	2F, 1M (CH) 3-6 years 2F, 2M (CH) 6-8 years 2F, 2M (CH) 8-11 years 2M (CH) 15-18 years	13/23
Purple	3F (CH) 3-6 years 2F, 2M (CH) 6-8 years 1F (CH) 8-11 years 1F(CH) 12-14 years 1F, 1M (CH) 15-18 years	11/23
Brown	2F, 1M (CH) 3-6 years 2M (CH) 6-8 years 2F, 1M (CH) 8-11 years 1F (CH) 12-14 years 2F (CH) 15-18 years	11/23
Pink	2F (CH) 3-6 years 1F, 1M (CH) 6-8 years 1F (CH) 8-11 years 1F (CH) 12-14 years 1F, 1M (CH) 15-18 years	10/23
Red	2F, 1M (CH) 3-6 years 2F, 2M (CH) 12-14 years 1F (CH) 15-18 years	8/3
White	2M (CH) 6-8 years 2F(CH) 12-14 years 1F (CH) 15-18 years	5/23
Turquoise	1F (CH) 3-6 years 2F, 1M (CH) 15-18 years	4/23
Black	2M (CH) 6-8 years 2F (CH) 12-14 years	4/23
Orange	3F, 1M (CH) 3-6 years	4/23

Figure 5: Children's (CH) preferences in terms of including colors in their favorite's spaces.

The participants' preferences in terms of colors are visualized and presented in Figure 6.

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Figure 6: The visualization map presents the participants of parents, children and medical staff prevalence of colours.

4. Discussions

Based on data analysis and findings, the participants of children and adults identified different preferences in terms of colors that provide them with comfort. The results determined that *few* adult participants and few children appreciated the inclusion of bright and light colors. The participants argue that these colors can be appropriate for children, particularly young children (aged 0-6 years). In some evidence, children do not appreciate using bright colors because they create a dynamic and chaotic nature in the atrium that produces a messy image (e.g., Koller and McLaren, 20128; Coad and Coad study 2008). In the literature review (e.g., Powers, 2009 & others), the young children and some scholars supported the inclusion of bright colors for children's spaces. Such colors contribute to "aesthetic experience," can improve the potential of learning, provide a child-friendly environment, and reduce stress (Chamari &Amoor., 2016). In addition to that, using soft colors in hospitals is supported because it provides a friendly environment (Trivorsak, 2004).

According to children, they identified eleven colors, but they have similarities and differences in their preferences in terms of the type of colors:

- nearest to all of them prefer green and blue;
- most of them prefer yellow;
- few of them prefer wood and purple;
- few of them prefer pink and red; and
- a very few prefer white, turquoise, black, and orange (Figure 7).

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Some of these findings have some similarities and differences with other empirical studies in the literature. For example, in Coad and Coad (2008) study, the participants of children aged between (3-18 years) preferred mid-blue green. However, in the same study, some young children aged more than 11 years preferred the darkest range of blues and a range of mid, warm yellow-orange, bold pinks, silver, and black.

The participants of adults identified different preferences in terms of thematic design colors that provide a comfortable environment in the public spaces of children's hospitals:

- Most of the parents, medical staff, and children appreciated including colors of nature (e.g., green colors). Parents and medical staff suggested including such colors in the main entrance to distract and attract children. In the literature review, there is inconsistency regarding the preferences of colors to be included for children's hospitals (Schneider, 2010). However, a variety of colors is recommended, such as blues, greens, and yellows, to provide calm environments (Powers, 2009; Dalke et al., 2004).
- Two of the parents prefer the inclusion of light colors in the reception areas. In the literature review, no evidence discusses such an issue. However, other studies (e.g., Zarrati, 2012) cited that designers used light colors for Subang Hospital, particularly the sofa, floor, ceiling, wall, to provide a calm feeling. Other studies (e.g., Tirovsak, 2004) encourage using neutral colors for sub-waiting areas in hospitals.
- Two of the medical staff appreciated including colors in the x-ray, main entrance, and triage room. In the literature, providing attractive x-ray is recommended to decrease children's fears (NHS Estates, 2004).
- Most of the medical staff and parents appreciated providing colors for the ground tiles to provide easy wayfinding. Some scholars acknowledge such an issue (e.g., NHS Estates, 2004; Tonkin, 2015).

In this study, there are some differences between four age ranges groups of children that the researcher included in this study:

- Most of the children in the age group (3-6 years) prefer the orange color. Few of them in the same age range preferred red, turquoise, and black colors. Such colors were not preferred by age ranges (6-8 & 8-11 years). However, *nearest* to all of the children in age ranges (6-8 & 8-11 years) strongly appreciated the inclusion of yellow colors, while it is less appreciated by age group (3-6 & 12-18 years). On the other hand, *few* children from age ranges (3-6 & 12-18 years) prefer the inclusion of red, turquoise, and black. But, the same colors are not preferred by age ranges (6-8 & 8-11 years).

The children aged between (11-18 years) are more appreciated the colors of green, blue, yellow, and purple. At the same time, they showed fewer preferences to the colors of turquoise, white, red, pink, orange, and black. Comparing these findings with the literature review, one can find some differences in children's preferences. For example, the children over 11 years in Coad and Coad (2008) study are more appreciated the dark range of mid warm orange, yellow and black colors. While they are less preferred by the same age range of children in this study, particularly, orange and black.

- The children aged 3-11 years are more appreciated, including green, blue, yellow, purple, and wood colors. Whereas the same group less enjoyed pink, red, white, turquoise, black,

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and orange. This finding links with Coad and Coad (2008) results in which the same age ranges of children were preferred the colors of blue-green, red-purple, and orange-yellow, but they do not appreciate wood colors.

The cross-analysis between all age ranges of the participants of children showed that:

- Green, blue, purple, and yellow are the most preferred colors that children preferred in this study. In the literature review, some scholars (e.g., Ceppi & Zini as cited in Del Nord, 2006) recommended not to use plain red, yellow and blue colors because they can cause aggressive behavior. At the same time, Tonkin (2015) indicated no longer using primary colors in hospitals because scholars have evaluated them as inappropriate. However, in a study by Lankston et al. (2010), the patients preferred nature scenes dominated by greens and blues because these colors can provide them with more pleasure.
- There is a minor difference between boys and girls only in the age range between 15-18 years where two girls preferred wood colors, but no one of boys preferred that, and two boys preferred yellow colors, but no one of girls preferred them. In Bosch et al.'s (2012) study, 153 children aged 7-11 years examined their preferences in terms of color. The finding showed a significantly lower preference for red and purple colors by males than females.
- There is a difference between boys and girls among the whole age ranges of groups presented that: five girls preferred white color versus no boys, eight girls versus three boys preferred purple colors, seven girls versus four boys preferred wood colors, and eight girls versus two boys preferred pink colors. Such findings link to Jiang et al. (2020) study where adolescents of girls preferred pink and purple colors than adolescents of boys.
- The participants of boys from all age ranges are more appreciated green, blue, purple, and yellow, and they less enjoyed red, pink, white, black, turquoise, and orange. Comparing such findings with another study, four colors (i.e., green, blue, purple, and yellow) were preferred by the boys of children in Zlotkowska and Cassidy study (no date).
- The pre-school children of this study (aged 3-5 years) were appreciated green, blue, yellow, purple, red, and orange. However, in another study, the pre-school children preferred the same colors, unless orange, but with some differences between boys and girls in the tones of colors in terms of its brightness, light, or pale (Zlotkowska & Cassidy, 2010).
- In this study, green, blue, purple, pink, wood, and yellow are the colors most appreciated by girls. Whereas green, blue, yellow, and wood are the most colors preferred by boys. Thus, **green, blue, wood and yellow** are the colors that have the highest preference for both/ boys and girls.

The field research identified four issues regarding *color* preferences related to gender. The findings showed a *difference* between boys and girls across the whole age range. For instance, three girls versus two boys preferred white, eight girls versus three boys preferred purple, six girls versus four boys preferred brown, and eight girls versus two boys preferred pink. However, boys from all age range preferred *green, blue, brown, and yellow*, and they liked less *red, pink, white, black, turquoise, and orange*. The colors most selected by girls are *green, blue, purple, brown, yellow, pink, and red*.

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Although children's preferences related to *colors* do alter according to age range; however, the field research findings showed six types of colors that are included by all age ranges of children. Such results did not support Piaget's theory that every age range will choose different kinds of colors. Such issues have a link to Eisen's research (2007).

These are **blue, green, yellow, purple, pink, and brown**. In this respect, choosing colors across the age ranges is not considered a significant factor of the four stages of cognitive development. Those colors identified (above) can be appropriate to all age ranges of children, particularly in the context of this study. In the literature review, there are studies with similarities to, and differences from, the above findings. Powers (2009) recommends using soft colors for walls (i.e., yellow, green, and blue) to promote calming. In a recent study using participatory research with 24 children aged 6-12 years in Iran, children prefer to include light green, yellow, and blue for children's hospitals (Nasab et al., 2020).

The field research identified children's preferences of colors across all age ranges-five issues were identified:

- Children's color preferences are yellow, purple, blue, green, and brown (3-7 years); blue, yellow, green, pink, and brown (7-11 years); and red, green, yellow, and blue (11-18 years).
- Most children in the 3-7 age group prefer orange, which other groups do not prefer.
- Most children from age groups 3-7 and 11-18 preferred red, which the 7-11 age group is not included.
- A few children aged 3-7 and 11-18 years preferred black and white, which the 7-11 age group does not prefer.

Children's color preferences across age ranges								
Age range	Type of colour	No	Age range	Type of colour	No	Age range	Type of colour	No
3-7 years	Blue	7/9	7-11 years	Blue	4/6	11-18 years	Green	7/8
	Yellow	7/9		Yellow	4/6		Yellow	7/8
	Purple	7/9		Green	4/6		Blue	6/8
	Green	6/9		Pink	3/6		Red	5/8
	Brown	5/9		Brown	3/6		Orange	4/8
	Pink	4/9		Purple	1/6		Pink	3/8
	Orange	4/9					Brown	3/8
	Red	3/9					Purple	3/8
	Black	2/9					Turquoise	3/8
	White	2/9					White	3/8
	Turquoise	1/9					Black	2/8

Figure 7: Children's color preferences across all age ranges (developed from Table 5.23)

5. Conclusions and Recommendations

This research identifies the thematic design of colors that are appropriate for the public spaces of children's hospitals, particularly in the context of Palestine.

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It is essential for interior designers and interior architects in Palestine when it comes to designing the interior of public spaces of children's hospitals to consider:

- The differences between genders of children regarding the inclusion of the colors purple, white, brown, and pink.
- Minor differences between genders of children regarding the inclusion of wood colors.
- No gender differences regarding the inclusion of colors related to blue and green.
- The differences across age range preferences and needs, specifically concerning the inclusion of bright and glittery materials, colors related to orange, turquoise, black, white, and red.

The findings showed various and different preferences related to children that do not alter according to children's age ranges and cognitive development. To provide age-appropriate design for all age ranges of children, the interior architecture and interior design of public spaces of dedicated children's hospitals should consider the provision of schematic colors related to green, blue, yellow, purple, pink, and brown. In addition to that, the interior designer and interior architecture of public spaces should include different types of colors, but with a concentration of using natural colors and light colors, and the use of colors as a way of coding to provide identity to the different areas and to help with wayfinding. It is evident that including colors concentrating on nature in the public spaces of children's hospitals can provide healing environments. Despite this, further research is needed to explore and test the findings in real-world design settings, such as children's hospitals in Palestine. Also, further research is necessary to include disabled children as this study has not included them because of time constraints.

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